PRINCIPES

JOURNAL OF THE PALM SOCIETY

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THE PALM SOCIETY

A non-profit corporation primarily engaged in the study of the palm family in all its aspects throughout the world. The Society relies on voluntary contribution for support, and membership is open to all persons interested in the family. Requests for information about membership or for general information about the Society should be addressed to the Executive Secretary.

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PRINCIPES

Journal of the Palm Society

An illustrated quarterly devoted to information about palms published on the first day of January, April, July, and October, and sent free to members of the Palm Society.

EDITOR: Harold E. Moore, Jr.

EDITORIAL BOARD: Paul H. Allen, David Barry, Jr., I. D. Clement, Walter H. Hodge, Eugene D. Kitzke, Harold F. Loomis, Nixon Smiley, Dent Smith.

Manuscript for PRINCIPES, including legends for figures and photographs, must be typed double-spaced on one side of 8½ x 11 bond paper and addressed to the Editor at Bailey Hortorium, Mann Library, Cornell University, Ithaca, New York, for receipt not later than 45 days before date of publication. Authors of one page or more of print will receive six copies of the issue in which their article appears. Additional copies or reprints can be furnished only at cost and by advance arrangement.

COVER PICTURE

RHYTICOCOS AMARA (foreground and in silhouette on bluffs at left) growing close to the Atlantic on the windward coast of Dominica, near Calibishie. Photo by W. H. Hodge.

Concerning Incorporation

During an informal meeting of your Society's officers in the early part of this year it was agreed that the present voluntary association that constitutes the Palm Society should be terminated as soon as feasible in favor of a corporation.

The purpose of incorporation is to ensure that individual members cannot be held liable for debts of the Society, since an unincorporated society or association is, in legal effect, in most states a partnership in which each of the members has an individual as well as a joint liability with the other members of the association. An incorporated society is a legal entity apart from its members and responsible for its own actions. Also, management of the affairs of the Society will be less cumbersome, and there is a greater possibility that contributions to an incorporated society may be made income tax deductible.

This note will serve to inform members that the Society was incorporated in the State of Florida on July 17, 1957. The necessary steps were taken following Section 10-D of the bylaws where, under Duties and Powers of the President, it is stated "he may take steps to incorporate the Society should any real necessity for incorporation arise."

Any member who wishes to see the charter and bylaws may write to the Executive Secretary who will furnish him or her with a copy.

W. H. Hodge, *President*
The Palm Society

NEW MEMBERS OF THE SOCIETY

Since the publication of a roster of members as of March 21, 1957, the Society has added 55 new members to its rolls for a total of 315. It is with pleasure that we welcome them into the Society and publish their names below. One new state and six new foreign countries are now represented, making a total of sixteen states, the District of Columbia, the Canal Zone, Hawaii and Puerto Rico, plus twenty-six foreign lands.

The Society is eager to hear from these new members, who we hope will send in items of interest about palms, or questions to which some other member perhaps has the answer. Please write to the Executive Secretary, who can pass on your letters to the proper persons. Of special interest are: what species of palms members are growing, and what methods are used to insure success. There is great need for a pooling of experience and information for the benefit of all.

Arizona

Mr. Dick Folger
2531 E. Edison
Tucson

California

Mr. Allen B. Davies
305 California Bank Bldg.
Beverly Hills

Mr. Donald Forbes
2883-220th Pl.
Long Beach 10

Mr. and Mrs. Winston H. Haase
Route 1, Box 58-A
Fillmore

Mr. Fred Mittwer
1056 No. de Garmo Dr.
Los Angeles, 63

Mr. Andrew M. Spinks, Jr.
224 N. Van Ness Ave.
Los Angeles 4

FLORIDA

Mr. Rudy Bachman
Bonita Garden
2180 N.W. 36th St.,
Miami

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Miami 43

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Miami 56

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109 N. 12th St.,
Dade City

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P. O. Box 245
Marathon

Mrs. Marjory Stoneman Douglas
3744 Stewart Ave.,
Miami 33

Mr. Owen Early
Early's Nursery
6121 S.W. 79th Ct.
Miami 43

Mrs. R. W. Eggert
1510-17th Ave., N.
Lake Worth

Mr. B. A. Fletcher
County - Box 811-IAB
Miami

Mrs. Lorraine L. Fredericks
4923-20th Ave., S.
Gulfport

Mrs. H. W. Gardner
Box 655
Sebring

Mr. W. E. Guthrie
P. O. Box 729
Punta Gorda

Miss Vesta E. Mangus
2301 N. E. 19th Ave.
Fort Lauderdale

Mr. A. C. Margraff
Box 295
Kendall

Mr. John H. Neidert
1811 N. W. 11th Rd.
Gainesville

Mr. Henry L. Nies
Nies Nursery
5710 Avocado Dr.
West Hollywood

Mrs. Louis C. Oakley
4411 Emerson Ave., S.
St. Petersburg

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Fla. Nursery & Landscape Co.
P. O. Drawer 281
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Route 1, Box 288A
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Route 1, Box 661
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Island Landscape Co.
P. O. Box 6428
West Palm Beach

Mrs. Leo C. Shippy
5136-31st Ave., S.,
St. Petersburg

Mr. L. J. Taylor, Jr.
Box 550
Eustis

Mr. and Mrs. Wm. E. Townsend
Floribunda Nursery
235 N.W. 59th Ave.,
Miami 44

Mr. Luke Whitlock
7461 Hardee Dr.,
Miami 43

ILLINOIS

Dr. B. E. Dahlgren
Chicago Museum of Natural History
Chicago 5

NEW YORK

Mr. L. J. Brass
American Museum of Natural History
79th St. at Central Park West
New York 24

PENNSYLVANIA

Mr. John E. Reed
170 W. Pike St.,
Cannonsburg

TEXAS

Mr. J. B. Chambers, Jr.
Box 1733
Harlingen

Mr. Boynton H. Fleming
483 W. Swanson
San Benito

Mr. Neil S. Madeley
1465 N. Shore Dr.
San Benito

HAWAII

Mr. Robert Allerton
Koloa
Kauai

Mr. Marshall M. Ross
2943 Kalakaua
Honolulu 15

PUERTO RICO

Mr. Edward Roehrs
Exotic Plants
Box 1, Garrochales
Arecibo

BELGIUM

M. Lucien de Clerq
Rue de Gand 227
Mont St. Amand

BRASIL

Sr. Roberto Burle Marx
Rua Gen. Ribeiro da Costa, 4
Leme
Rio de Janeiro

Sr. Hernani Urpia
Caixa Postal 798
Salvador
Bahia

COLOMBIA

Sr. Jesus M. Idrobo
Apartado Aereo 7495
Bogotá

EL SALVADOR

Sr. Francisco de Sola
Ave. Morazán No. 1
San Salvador

GERMANY

Dr. Max Burret
Botanisches Museum
Königen Luise Str. 6-8
Berlin-Dahlem

Dr. Eva Potztal
Botanisches Museum
Königen Luise Str. 6-8
Berlin-Dahlem

GUATEMALA

Mr. R. A. White, Jr.
AFSD—ICA USOM
c/o American Embassy
Guatemala City

INDONESIA

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Director Herbarium Bogoriense
Kebun Raya Indonesia
Bogor

Dr. L. M. Olah
Treub Laboratory
Kebun Raya Indonesia
Bogor

MEXICO

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Escuela Nacional de Agricultura
Chapingo, Mex.

Mr. Gordon B. Ross
Central Pte. No. 2
Tapachula
Chiapas

Dr. E. J. Wellhausen
Rockefeller Foundation
Londres 40
Mexico, D. F.

PARAGUAY

Prof. Dr. Miguel Michalowski
Casilla de Correo 819
Asunción

ADDITIONAL NEW MEMBERS

Mr. Joseph D. Sullivan
3551 Telegraph Road
Ventura, California

Mr. Fred H. Gick, Jr.
P. O. Box 175
Lockhart, Florida

Mr. Malcolm S. H. Kneale
829 Avenue Majorca
Coral Gables, Florida

Mrs. W. R. Robinson
707 Seminole Street
Key West, Florida

Mr. Robert L. See
3039 S. W. 6th Street
Miami 35, Florida

Mr. Robert M. Spiecker
5201 S. W. 101st Street
Miami, Florida

Mr. Randolph M. Thomson
320 W. Enid Drive
Key Biscayne, Florida

Mrs. Morris W. Clint
2002 Palm Blvd.
Brownsville, Texas

PALM SOCIETY SEED BANK

Because of the difficulty of obtaining seeds of any but the commonest palms, the Society has decided to establish a palm seed bank strictly for the benefit of its members and with a view to increasing the practical value of the Society's work to its members. Any member wishing to take advantage of this service should send his name along with his request to the Executive Secretary, Mrs. Lucita H. Wait, 7229 Southwest 54th Avenue, Miami 43, Florida.

Because of the short viability of palm seeds, it is practical at present to use seeds collected in the South Florida area only. The Society is greatly indebted to Fairchild Tropical Garden, The United States Plant Introduction Garden at Coconut Grove, Mrs. Alvin R. Jennings and Mr. and Mrs. A. C. Langlois of Nassau, for making seeds available for distribution.

Members may request seeds of such palm species as they wish, but the Society cannot possibly consider sending out seeds in commercial quantities. Nurserymen interested in commercial quantities should write to Fairchild Tropical Garden, Box 407, Coconut Grove, Miami 33, Florida, for particulars. The number of seeds sent out will depend on the supply, demand, and the size of seeds. A number of palms offered are not prolific fruiters and it may take a year or so before all requests for seed of such palms can be filled. The bulk of the seeds will be available from July to November, for the majority of seeds ripen at that time.

A charge of 50 cents for each seed pack requested will be necessary to cover handling costs. Where foreign requests are concerned, arrangements should be made in advance with the Executive Secretary. Seeds will be sent by either regular mail or airmail, depending upon their destination and the known viability of the seeds.

The Society is offering seeds of a wide selection of palms suitable for any landscape situation or collection. In time this list will be expanded. Interested members who have access to fresh crops of seeds not included on our list, either in this country or abroad, are urged to write to the Executive Secretary so that arrangements for distribution can be made.

Seeds Available for Distribution

Acrocomia armentalis
sclerocarpa
Totai
Adonidia Merrillii
Aiphanes acanthophylla
caryotaefolia
Lindeniana
Archontophoenix Alexandrae
Cunninghamiana
Areca triandra
Arecastrum Romanzoffianum
Arenga Engleri
Arikuryroba schizophylla

Butia Bonnetii
capitata
Nehrlingiana
Caryota Cumingii
mitis
urens
Chamaedorea concolor
erumpens
Tepejilote
Chrysalidocarpus lucubensis
lutescens
madagascariensis
Coccothrinax alta
argentata
crinita
Dussiana
Copernicia glabrescens
hospita
Torreana
Corozo oleifera
Dictyosperma album
album var. rubrum
aureum
Elaeis guineensis
Gaussia attenuata
Heterospathe elata
Hexopetion mexicanum
Latania borbonica
Loddigesii (probably a hybrid rather than the species itself)
Livistona chinensis
decipiens
Mascarena lagenicaulis
Verschaffeltii
Opsiandra Maya
Orbignya Cohune
speciosa
Paurotis Wrightii
Phoenix canariensis
dactylifera
farinifera
reclinata
Roebelenii
Polyandrococus caudescens
Pritchardia pacifica
Thurstonii
Pseudophoenix Sargentii
saonae
vinifera
Ptychosperma elegans
Macarthuri
Roystonea elata
regia
Sabal causiarum
exul
minor
Palmetto
parviflora
umbraculifera
Scheelea Lauromuelleriana
Serenoa repens
Syagrus coronata
flexuosa
Treubiana
Thrinax microcarpa
Morrisii
parviflora
Trithrinax acanthocoma
brasiliensis
Washingtonia filifera
robusta
Zombia antillarum

The Genus Pritchardia—Loulu Palms

L. W. BRYAN

The interesting genus *Pritchardia* contains thirty-seven species plus six varieties, most of which are endemic to the Hawaiian Islands. In 1921, Beccari and Rock published *A Monographic Study of the Genus Pritchardia* (Memoirs of the Bernice Pauahi Bishop Museum 8 (1)—Honolulu). At that time, they described thirty-three species and five varieties, including *Colpothrinax Wrightii (Pritchardia Wrightii)* of Cuba which is now generally considered distinct. Of this number, all of the varieties and twenty-one of the species were discovered by Rock. *Pritchardia* is the only genus of palms which occurs naturally in Hawaii except, of course, for the common coconut which has been distributed all over the tropical world.

The original palms found in Hawaii,

PRITCHARDIA BECCARIANA. Left, trees growing naturally in rain forest, Waiakea Forest Reserve, Island of Hawaii, elevation 1,000 feet; right, a tree forty years old growing in Kalakaua Park, Hilo, Hawaii, near sea level.

and now classified as *Pritchardia*, were at first considered as belonging to the genus *Livistona (L. Martii* and *L. Gaudichaudii* being the first two species found). The name *Pritchardia* was established afterwards (1860) for a palm found growing in Fiji *(P. pacifica*, Seem. & H. Wendl.) where *P. Thurstonii*, F. Muell. & Drude was also found. Later, *Livistona Martii* H. Wendl. and *L. Gaudichaudii* H. Wendl. were placed in this genus. Other members of *Pritchardia* are found in the Dangerous Archipelago (*P. Vuylstekeana* H. Wendl. and *P. pericularum* H. Wendl.).

How did the genus reach Hawaii? And after this genus arrived in Hawaii, how was it spread? The seed of most species is too large to be carried by any native Hawaiian bird. Many species occur naturally on isolated inaccessible knifelike ridges. The seed being large and heavy, it is understandable that it would roll down and germinate below the parent tree. But how did the original plant secure a foot-hold near the summit? I wish that I could answer these questions. They pose an interesting problem.

Pritchardia Beccariana (named by Dr. J. F. Rock in honor of the late Dr. Odoardo Beccari of Florence, Italy, a well-known authority on the tribe *Corypheae)* pictured here is one of the many species endemic to Hawaii. This species occurs in the heavy rain forest (150 inches to 300 inches of rain per annum) at elevations of from 1,000 to 5,000 feet. At its maximum upper elevation it withstands several degrees of frost. It is slow-growing, living for many years, and may be planted at lower elevations where it makes an attractive street tree. The tree pictured has been

growing in the City of Hilo for about forty years.

Although most species seed freely, fertile seeds are not always easy to obtain. Tree rats are very fond of them and climb the trees in order to eat them. Seed which happens to reach the ground is usually eaten by wild pigs, and the seed of some species is attacked by an insect. However, seed is occasionally available and can be supplied to anyone interested in limited quantities.

Notes on Pritchardia

HAROLD ST. JOHN

(Reprinted without the footnotes from *Bernice P. Bishop Museum Occasional Papers* 9(19): 3-5, 1932, by permission of the Museum.)

Nectar Secretion

The palm trees of the genus *Pritchardia* are known from 38 species: 1 from Cuba and the Isle of Pines in the West Indies, 30 (and 6 varieties) from Hawaii, 2 from Fiji, 2 from the Tuamotus, and 3 from rather indefinite locations in Polynesia.

The genus has recently been given a monographic study by Beccari and Rock in which Professor Beccari states that he has no evidence that the flowers of these palms secrete any nectar.

On collecting trips to the upper ridges of the Koolau Mountains of Oahu I have become acquainted with several of the species. On January 19, 1930, the type locality of *Pritchardia martioides* Rock and Caum was visited. Here on the divide between Kahana and Wahiawa, where they are a conspicuous feature of the vegetation, the trees attain a height of 30 feet in the woods below the crest, whereas at the nearly bare, wind-swept divide the dwarfed trees fruit at a height of 5 feet. Specimens were collected on the Wahiawa side (St. John no. 10180). One of the panicles contained numerous unopened buds. During two days in the laboratory many of its flowers opened. After the dehiscence of the cap of petals, the large anthers radiate out at an angle of 45 degrees. The free tip of each filament is subulate and 2-2.5 mm. long. The anthers are borne by a staminal cup, 6 mm. long, which often protrudes 2 mm. above the calyx. The ovary is seated in the base of this cup, and the stigma barely equals its rim. Fully formed buds are dry within, but those just mature are found to be nearly filled with liquid. After anthesis, the staminal cup is brimming full of a viscous, yellowish liquid that is perceptibly sweet to the taste. Professor R. S. Bean kindly aided in testing this liquid. With a capillary pipette two large drops were collected from some ten flowers. With Fehling's solution a strong test for sugar was obtained.

Careful dissection did not reveal any localized nectar glands. However, the whole staminal cup is of yellow tissue, 0.5 mm. thick. Its inner surface glistens and seems to be glandular and to secrete the nectar generally over its entire area.

On February 14, 1932, several groves of *P. Rockiana* Beccari were discovered at altitudes of from 1500 to 1800 feet on Laie-Malaekahana Ridge in the Koolau Range, Oahu. The weather was rainy, and the specimens collected (St. John no. 11559) showed no nectar. The next morning fresh flowers opened in the laboratory. All these had their staminal cups filled with sweet nectar.

It can now be stated that, at least in *P. martioides* and *P. Rockiana*, nectar is secreted in abundance.

Validity of the Hawaiian Species of Pritchardia

In 1888 Hillebrand recognized two species and a suggested but unnamed variety of *Pritchardia*. Subsequent local collectors gradually added to the knowl-

edge of this striking group of palms. The work culminated in that of Rock, who made extensive explorations and collections and cooperated with Beccari in a monographic revision of the genus. In the body of the text and the appended section, these authors recognize 25 species and 5 varieties in the Hawaiian islands. This number has been raised by the publication of 5 additional species and 1 variety by Caum.

Of this considerable total, 10 species and 1 variety are from the island of Oahu. The plants are not common; they appear as small groves along the ridges or in the upper valleys of the two principal mountain ranges, the Koolau and the Waianae. The present system of classification has practically resulted in recognizing each grove of trees as a distinct species or variety. This large number of species with minute ranges is uncommon, but not incredible.

In the Koolau Mountains in the valley of Kaluanui Stream at an altitude of 1960 feet on December 8, 1929, I found a small grove of small trees of *Pritchardia*. Flowering and fruiting branches and a leaf were collected and the trees were photographed. On either slope of the valley were a few larger, scattered trees. On checking up the material, I found it to differ in many particulars from any described species. Wishing to verify these observations, I revisited the grove on September 28, 1930, and made additional collections from the same tree. I was much surprised to find on careful study that the 1930 collection differed conspicuously from the 1929 collection, gathered from the same tree. The 1929 specimens showed glabrous floriferous branchlets, and the fruit was subspherical, 4.5 by 4.5 cm. The 1930 specimens had densely rusty tomentose floriferous branchlets, and the fruit ellipsoid, 4.5-4.8 by 2.8-3.2 cm. To be sure, the 1930 fruits were not fully ripe, but they were nearly so, and, I suspect, as much so as many of the specimens upon which species have been based. Several other scattering groups of Pritchardias were found on the Punaluu-Kaluanui divide at altitudes between 2200 and 2400 feet. They were in exposed situations and were all low trees with small leaves and short petioles. They were in all stages from bud to fully ripened fruit. The flowering and most of the fruiting branchlets were rusty tomentose, but on the tree with the largest fruits, the fruits were broadly ellipsoid to suborbicular, 4.5-5.5 cm. long and so ripe that they had turned dark brown. On this specimen the panicle was apparently glabrous, though close examination revealed that they were really glabrate. So this grove provided a confirmation of the inconstancy of the pubescence of the floriferous branchlets.

The key in Beccari and Rock's monograph is poorly constructed, but its lengthy paragraphs detail numerous characters and indicate those considered important. Great emphasis is laid on the pubescence of the floriferous branchlets, whether glabrous, glabrate, or permanently rusty tomentose, and on the shape and size of the fruits. Also the length of the petiole and leaf blade and the pubescence are indicated as of fundamental importance.

I have not made lengthy or extensive studies of the Hawaiian Pritchardias, but when a tree from an unreported grove is, upon the accepted standards of classification, one new species in 1929 and still a different one in 1930, I feel qualified to report the fact. Incidentally I shall refrain from publishing either of the apparent species. Also I challenge the validity of the taxonomic characters that have been used to divide the genus *Pritchardia* into such a large number of species. Under varying ecological conditions and different stages of maturity, they show considerable variability. Mr. E. L. Caum has observed that many of the species of *Pritchardia* cultivated in Honolulu, including some planted by J. F. Rock from type collections, are now so much modified by their growth under artificial conditions that it is impossible to make them fit into the described species.

Current Work on the Systematic Anatomy of Palms

P. B. TOMLINSON

Department of Botany, University College of Ghana.

Introduction

There is at present no up-to-date summary of the anatomy of the monocotyledons comparable to Metcalfe and Chalk's *Anatomy of the Dicotyledons* which was published in 1950. At the moment the only existing publication is Solereder and Meyer's *Systematische Anatomie der Monokotyledonen* which, besides being practically unobtainable, is incomplete because the proposed volumes on many of the larger groups, including the *Glumiflorae* and the *Liliflorae*, never appeared. However, since the completion of the *Anatomy of the Dicotyledons*, Dr. C. R. Metcalfe of the Jodrell Laboratory, Royal Botanic Gardens, Kew has been working on a comparable survey of the monocotyledons which will include all available information on the anatomy of all families within the group together with taxonomic notes and notes on economic uses. At the moment a survey of the anatomy of grasses is almost complete and the anatomy of a number of small families has been described.

The work which the present paper sets out to describe is part of this larger project and has been in progress for two years. Although this work is by no means complete it is possible at the moment to derive some tentative conclusions from the observations which have been made so far. These are presented here for the first time. The study was started at the University of Leeds on material collected from the glasshouses of the Royal Botanic Gardens, Kew. Subsequently a visit for one year to Singapore was of tremendous benefit in that some firsthand knowledge of the native palms of Southeast Asia in their natural habitats was gained and at the same time access to the large living collection in the Singapore Botanic Gardens was granted through the kindness of the Director, Mr. J. W. Purseglove. As a result a large collection of preserved material of Asian palms was assembled. At the moment West Africa is providing abundant material of its few local palms. Very little work has been done on American palms because of lack of material, but Dr. H. E. Moore, Jr. of the L. H. Bailey Hortorium is co-operating in making good this deficiency.

Scope and Purpose of the Work

The object of the study is to provide a survey of the anatomy of the vegetative organs of palms which will include all existing information on the subject. The results will be presented in such a way that the relation between the anatomical findings and the taxonomy of palms will receive special emphasis. The scope of this anatomical approach to traditional systematics has already been outlined very adequately by Metcalfe in *Science Progress* 161: 42, 1953. It is therefore only necessary to re-emphasize here that the object of systematic anatomy is not to derive a classification of plants (in this instance palms) from their anatomical structure but to indicate in what way existing classification, based on traditional exomorphic vegetative and floral features, is supported by internal microscopic structures. Where evidence from both disciplines is in agreement, the conclusions arrived at have a more probable validity, but where results do not agree, the anatomist can only suggest that a re-investigation of the problem by the taxonomist may produce modifi-

cations which will lead to mutual satisfaction. Also it must be remembered that external morphology and internal anatomy are only two sources of information from which our ideas on the natural affinities of plants may be derived and that cytology, pollen morphology, and even biochemistry can supply further useful information.

It must also be remembered that taxonomy is concerned in the first place with the identification of plants, as well as determining their probable phylogenetic relations. In this respect the anatomist is much less useful than the taxonomist, although it cannot be denied that anatomical information may be very useful in identifying sterile material and in particular in identifying plant fragments.

Ultimately the structure of all vegetative organs of palms will be described, but at the present moment attention has been largely concentrated on the lamina (leaf-blade) and very little work has been done on the anatomy of stem and root. Even so it appears that the lamina will offer far more useful information, because of its greater variability, than either stem or root which are rather uniform in structure. In addition the lamina is always more easily accessible than other organs.

Collecting and Preserving Material for Systematic Anatomical Work

When a survey of the anatomy of such a large family as the *Palmae* (about 2,600 species) is to be attempted, only a small sample, which must include as many groups as possible, can be studied. In addition, for plants as large as palms it is not possible to describe in detail the anatomy of all parts. For this reason certain restricted but standard regions have been selected for study. These regions are:

i) the *lamina*, either as a pinna at the median level in the feather palms, or a portion of a leaf segment at a median level in the fan palms.

ii) the *rachis*, just below the insertion of the lamina or lowest pinnae.

iii) the *leaf sheath*, at a less precise level, but usually just above its insertion on the stem.

iv) the mature *stem*, including a portion of the inner and outer regions.

v) mature *roots*.

Obviously some parts of a palm are more accessible than others. The lamina is most easily obtained. This is important because the most useful information is obtained from the lamina. The stem is least accessible since it is necessary to cut down and destroy a shoot in order to obtain it. This cannot be done with single-stemmed palms in cultivation. Roots require a little effort in excavating near the base of the stem, but they can be taken without harming the living plant.

After the material has been obtained from the living plant, usually with considerable effort using large knives and saws, it is carefully cut into small enough pieces to go into screwtop preserving jars and is fixed in formalin-acetic-alcohol in which it will maintain its condition more or less permanently without deterioration. In this way a very large collection of dead, preserved material has been obtained from living plants. In order to transport these rather bulky objects it has been found very convenient and affords much saving of space if the material is taken out of its jars of preservative and sealed airtight, together with a small wad of cottonwool soaked in formalin-acetic-alcohol, in polythene bags.

In addition to material derived from living plants much valuable information has been obtained from dried leaf material taken from herbarium or museum specimens. This is often the only source of information about rare and little-known plants. Through the kindness of Dr. C. X. Furtado I have had material from several of the type specimens in the Singapore Herbarium. By simple

techniques it is usually possible to revive dried material adequately so that its internal structure can be examined. In one instance material in one of the Kew museums collected by Alfred Russel Wallace in the Celebes nearly one hundred years ago has proved amenable to anatomical study.

Preparation of Palm Leaves for Anatomical Study

Serious technical difficulties were encountered when attempts were made to prepare thin sections of all organs of palms for microscopic study. At the moment only those relating to the lamina have been overcome and can be described.

Preparations in which the surface layers can be studied in surface view are made by laying a piece of the lamina flat upon a glass slide and scraping away as much unwanted tissue as possible. These preparations can be cleared, stained, and mounted in the same way as sections. Difficulties involved in sectioning the leaves of palms are largely due to their high silica content but soaking material in hydrofluoric acid overcomes this. In order to save as much time as possible, lengthy embedding procedures were avoided. It was found that sections could be cut as thin as 10 micra without embedding the lamina, using a Reichert sliding microtome. This made possible a much more rapid advance than might have been otherwise. Although all sections have been examined unstained and untreated, a number of permanent stained preparations have been mounted. For this a special technique was developed for rapid handling of the very delicate free-hand sections produced on the sliding microtome. These permanent slides will ultimately be housed at Kew, where they will form part of the reference collection in the Jodrell Laboratory.

The Anatomy of the Palm Lamina

In order that the subsequent discussion may be fully understood a brief description of the structure of the lamina of palms may prove useful. The pinnae of feather-leaved palms and the segments of fan-leaved palms contain a system of alternating large and small veins which run parallel with each other and more or less longitudinally in the pinna or leaf segment. This system of veins is usually visible to the naked eye. In addition there is a system of short transverse veins connecting the longitudinal veins. These may or may not be visible to the naked eye. From transverse sections of the lamina the conducting tissue of these veins is seen to be sheathed by one or more layers of cells. The smaller veins are usually sheathed only by thin-walled parenchyma cells while the large veins may be sheathed either by parenchyma cells and fibres or even by fibres alone. The transverse veins contain only a few conducting elements and are sheathed either by thin-walled or by thick-walled cells. In addition to the fibres which form part of the vascular bundle sheath, the leaves of palms usually possess scattered fibres or longitudinal fibre strands which are not associated with vascular tissues.

The fibre and vascular strands are embedded in thin-walled assimilating tissue which contains most of the chlorophyll found in the lamina. This chlorenchyma may be differentiated into columnar palisade cells towards the adaxial (upper) surface and rounded, loose spongy tissue cells towards the abaxial (lower) surface, as in most dorsiventral leaves, but very often the mesophyll is uniform and is made up of cells which are all alike.

The surface layers which form the rest of the leaf tissue are often very complicated. In addition to the epidermal cells, which may or may not have thick outer walls and a well developed cuticle, there is usually one or more layers of so called "water-storage" cells below each epidermis. These hypodermal cells are usually large, colourless and thin-walled. Narrow longitudinal bands of these cells in certain precise

regions of the lamina become considerably enlarged and anticlinally extended. Since these are believed to bring about the expansion of the folded lamina they have been called "expansion cells." The epidermis itself frequently bears scales, warts or hairs of various kinds which may be visible to the naked eye as small flecks on the surface of the lamina.

Anatomical Features of the Leaf Which Are of Diagnostic Value

Before any morphological feature, whether external or internal, can be used for purposes of classification it must first be established that the structure does not alter as the environment of the whole plant is changed. It is because the floral and reproductive organs of flowering plants are very constant in their appearance within a single species that they are most useful in taxonomic work. In the same way those anatomical features selected to aid the taxonomist must not be plastic structures which are easily altered by changes in the habitat of the plant. For instance, it is well known that the mesophyll of a single species has quite a different appearance in a leaf grown in full sunlight than one allowed to develop in shade, whilst on the other hand, the structure of hairs would not be altered by a similar environmental change. Under these circumstances, therefore, the mesophyll is much less useful as a diagnostic feature than is the type of hair.

With this proviso in mind, the following paragraphs give a very brief summary of the more important structures in the leaves of palms which are believed to be constantly present within a given species and to provide useful criteria for the identification of taxonomic groups of palms.

i. Symmetry of the lamina

Most palms have dorsiventral symmetry in which upper and lower halves of the lamina are different. Stomata, for instance, are usually restricted to the lower surface. The upper mesophyll layers are sometimes differentiated into columnar palisade layers, while the cells of the lower mesophyll remain rounded and rather loose. However, there are a number of palms, such as *Phoenix*, *Borassus*, *Sabal* in which the leaves have an isobilateral symmetry with identical upper and lower surfaces and in which the structure of the mesophyll cells below each surface is the same. In other plants in which this symmetry is developed e.g. *Iris*, the leaves usually stand erect so that both surfaces are equally illuminated. Similar ecological conditions may be expected to have induced this structure in those palms with isobilateral leaves. Certainly in *Phoenix* the pinnae remain rather closely folded and might be expected to receive equal amounts of sunlight on upper and lower surfaces. However, the condition must be determined genetically in the first instance since the differentiation of tissues is complete in the folded lamina long before it becomes exposed to light. Also it is rather difficult to accept this explanation for *Sabal* leaves which normally have the lamina extended horizontally.

ii. The shape of the epidermal cells in surface view

The shape may be rectangular, if the cells are extended longitudinally; or rhombohedral, if the cells are extended obliquely; or hexagonal, if the cells are extended transversely, although this last condition is rare. In any one group of palms the shape of the epidermal cells is constant. Thus in the *Sabal* tribe the cells are always rectangular (Fig. 7) whilst in the arecoid palms they are probably always rhombohedral (Fig. 5). Also the anticlinal walls of the epidermal cells in surface view may be either linear, or undulate (Fig. 6). Presence or absence of undulate walls seems to be fairly constant for any one species, so that a useful diagnostic feature is available. Thus, for example, in the *Sabaleae* it is remarkable that all American representatives have linear epidermal walls while most Asian genera have undulate walls, a fact first noted by

Pfister in 1892 (cf. Figs. 6 and 7). The epidermal cells of most members of the *Lepidocaryoideae* have anticlinal walls which are undulate.

iii. Stomata

Although the structure of the stomata is very uniform in the palms as a whole and corresponds in general to the alismatoid type (Fig. 8), certain genera or groups of genera have peculiarities in the construction of their stomatal apparatus by which they can be identified. For instance, all members of the small tribe *Caryoteae* have peculiar striations in the walls of the guard cells which are very conspicuous in surface view (Fig. 10). *Sabal* (Fig. 12) and *Chamaerops* are among those genera which can be recognised from the appearance of their stomata in transverse view. In this respect *Nypa* is a well known example because the stomatal pores are occluded by numerous horizontal thickenings of the wall of the guard cells.

iv. Trichomes

Although there are a few palms in which excrescences are limited to the midrib region (e.g. *Phoenix*) many bear peculiar appendages on the surface of the lamina the structure of which is very constant and may be diagnostic for the genus or tribe to which the palm belongs. The peculiarity of these structures is that in the still folded leaf they produce a filamentous or scalelike expanse of thin-walled cells which is sloughed off when the leaf expands. Consequently, all that remains in mature leaves are the shrivelled remains of the thin-walled cells borne upon basal thick-walled cells. The latter, however, may have a characteristic arrangement which is easily recognised (Fig. 11). In a few palms — e.g. *Arenga*, *Diplothemium*, *Ceroxylon*, *Latania* — the thin-walled cells persist and become filled with air, so producing a glaucous or feltlike bloom on the undersurface of the leaf. In the bactrid and calamoid palms small multicellular spines are common which show a gradual transition in size to the large spines with which these plants are so fiercely armed.

v. Hypodermis

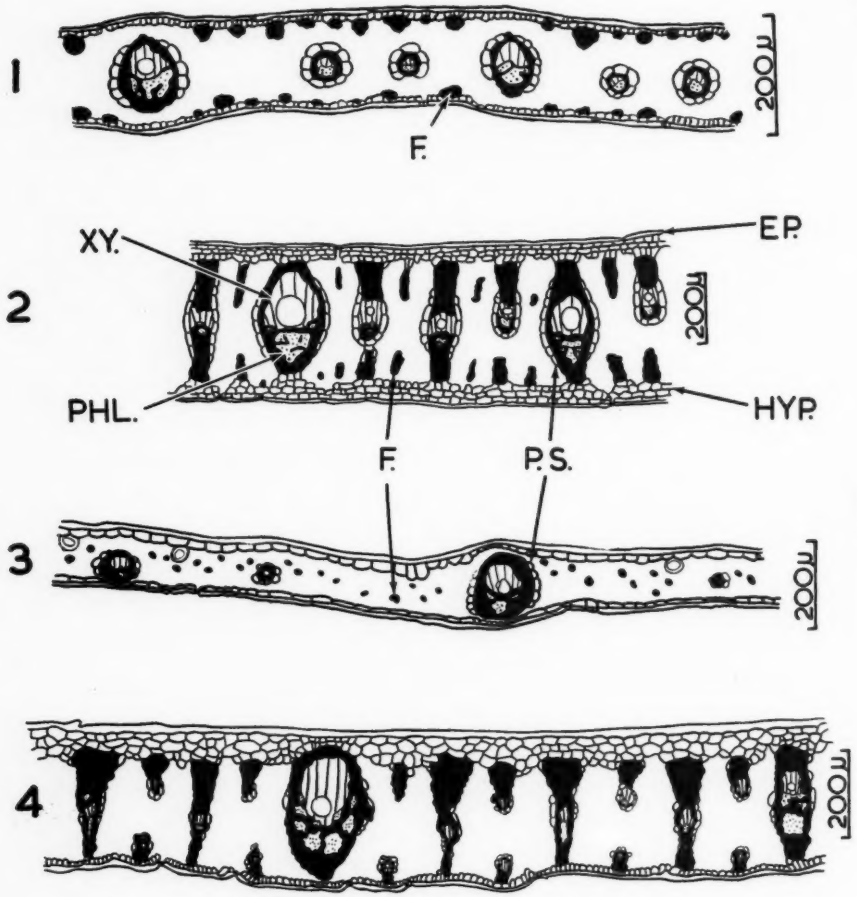
Although the number of layers of enlarged hypodermal cells varies in different parts of a single leaf, at any standard level it is always constant for each species. Usually there is one hypodermal layer beneath each surface (Figs. 1 and 3), but there may be more or there may be unequal numbers on opposite surfaces. As examples, at the standard levels studied, the arecoid palms nearly always have one hypodermal layer beneath each epidermis; *Jubaea* (Fig. 4) has 2-4 adaxial layers, one abaxial layer; *Hyphaene* (Fig. 2) has 3 layers beneath each surface. In addition the shape of the hypodermal cells as seen through the epidermis varies from group to group because the cells may be either transversely or longitudinally extended. Further, the hypodermal cells situated around the substomatal chambers usually have a very definite arrangement which in such genera as *Phoenix* (Fig. 9), *Borassus*, *Lodoicea*, and *Pritchardia* is very distinctive.

vi. Expansion cells

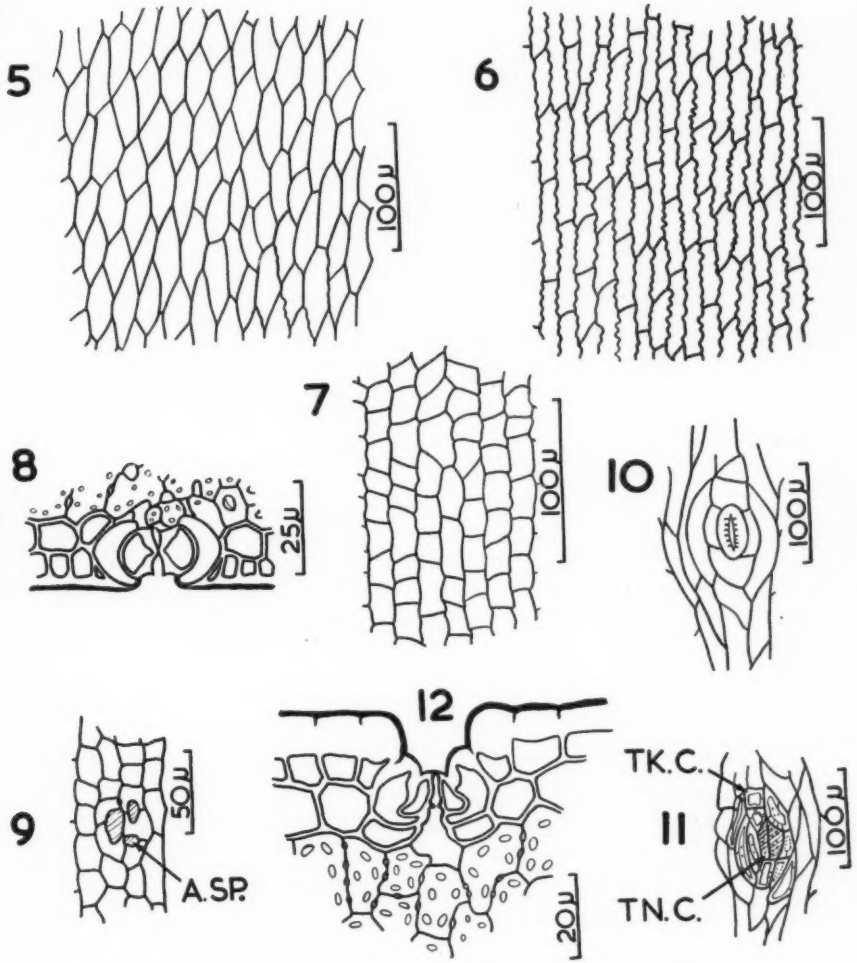
The bands of enlarged hypodermal cells which are assumed to cause the unfolding of the expanding lamina have a fairly restricted position which is constant for each species. For instance, the fan-leaved palms have a band of expansion cells within the angle of each fold of the lamina. In the feather-leaved palms the expansion cells appear to be distributed in two main ways; either there is a band of cells on each side of the midrib, or the cells are not present in the midrib region but are distributed at irregular intervals throughout the lamina.

vii. Fibre strands

The position of the strands of fibres which are independent of the sheathing fibres of the vascular bundles is very varied and many groups of palms have their own distinct type of arrangement.



Figs. 1—4. DIAGRAMMATIC TRANSVERSE SECTION OF THE LAMINA. 1, *Phoenix reclinata;* 2, *Hyphaene thebaica;* 3, *Didymosperma Hookerianum;* 4, *Jubaea chilensis.*—sclerotic tissue—solid black; xylem—vertical lines; phloem—stippled; ep.—epidermis; f.—fibres; hyp.—hypodermis; phl.—phloem; p.s.—parenchyma sheath of vascular bundle; xy.—xylem.



Figs. 5—7. ADAXIAL EPIDERMIS, SURFACE VIEW. 5, *Ptychosperma Macarthuri*; 6, *Cyrtostachys Lakka*; 7, *Coccothrinax argentea*; 8, *Phoenix canariensis*, t.s. stoma; 9, *Phoenix canariensis*, hypodermis, surface view, with substomatal cells; 10, *Caryota mitis*, stoma, surface view; 11, *Caryota mitis*, base of epidermal hair, surface view; 12, *Sabal mexicana*, t.s. stoma. —a. sp.—intercellular air-space; tk. c.—thick-walled cells; tn. c.—thin-walled cells.

Often the fibre strands are limited to a position in contact with the surface layers (Fig. 1) while on the other hand they may be limited to the mesophyll (Fig. 3). Yet again, as in *Jubaea* (Fig. 4), the fibres may be found only as large vertical extensions of the sheath tissue of the vascular bundles. Many combinations of these types exist, e.g. *Hyphaene* (Fig. 2).

viii. Vascular bundles

The distribution of vascular bundles in relation to the other tissues of the leaf is very variable and imparts a characteristic appearance to the transverse section of the lamina. Often all vascular bundles are connected by fibrous extensions of their sheathing tissues to the surface layers (Figs. 2 and 4). They may be connected mostly either to the upper or lower surface. On the other hand the vascular bundles may be largely independent of the surface layers (Figs. 1 and 3). Then they may be situated either at the centre of the lamina or approach closely to one or other of the surfaces.

The structure of the individual vascular bundles may provide useful features for diagnosis. This depends on the amount of fibrous supporting tissue, the distribution of sheathing parenchyma cells, the amount of xylem, and number of phloem groups, any of which features may vary considerably and so alter the appearance of the vascular bundle in transverse section.

In addition to the longitudinal bundles the size and distribution of the transverse vascular bundles provide useful taxonomic characters. For instance, in the tribe *Attaleeae*, at the points where the two vascular systems cross, the transverse bundles always run above the longitudinal. Large transverse bundles sheathed by fibres are very common in the tribes *Sabaleae* and *Borasseae*, while in the arecoid palms small transverse bundles sheathed by parenchyma are the rule. The genus *Borassus* can be recognized easily by the massive fibre buttresses which connect the transverse bundles to both surfaces.

ix. Stegmata

Situated adjacent to the fibre of palm leaves are small cells, each containing a single silica body, the cells being arranged in long files or, less commonly, in small groups. The individual cells have been termed stegmata. They have been observed in all palms, although their number varies considerably from species to species. The shape of the silica body and the extent to which the walls of the cells are thickened is very distinctive for each group of palms. For example, in the *Caryota* tribe, the silica bodies are shaped like small bowler hats and the silica cell is thin-walled. In the arecoid group the silica cell is also thin-walled but the silica body is spherical, while in the *Borassus* tribe the silica bodies are spherical but the wall of the silica cell adjacent to the fibre is always thickened and more or less envelops the silica body. Consequently, in this last group, when the silica body is dissolved away by means of hydrofluoric acid an impression of its shape is left in the wall of the silica cell.

x. Miscellaneous

In addition to the structures described above there are many others which have not been mentioned but which may be confined to a limited number of palms and provide very reliable means of identification. Sometimes similar structures may be found in totally unrelated genera. For instance, there are a number of genera which contain fibrelike sclereids, of which *Bactris*, *Daemonorops* and *Licuala* are examples although these are members of very different tribes. However, because they contain sclereids while closely related members of the same tribe do not, a means of recognising them within their small group is available. In the same way there are several members of the *Sabaleae* and *Lepidocaryoideae* which have a sclereid-like extension of the individual fibres of the sheath of the transverse vascular bundles. Here the fibres run parallel with the vascular tissues for some distance and then their ends are turned

away to ramify among the adjacent mesophyll cells. Stone cells have been found only in *Lodoicea*. The wax palm, *Ceroxylon andicola* can be recognized by the deep longitudinal grooves in the lower surface of the lamina to which the stomata are confined. As more material becomes available and is examined, more structures distinctive of individual palms may be brought to light.

Discussion and Conclusions

Before outlining a few of the taxonomic conclusions suggested by those observations on the anatomy of palms that have so far been made, it is well to remember that these conclusions are never derived from the consideration of single characters alone, but from the sum total of similarities and differences between different groups. Were this not so it would be possible to classify palms according to some quite artificial scheme, such as placing together all those palms which have sunken stomata or spherical silica bodies or thickened epidermal cells. This would give quite a different result to the modern system which takes into account as many features as possible. As a matter of fact, palms from obviously unrelated groups often possess common structure. As examples it has already been mentioned that isobilateral leaves are found in many tribes; that sclereids are developed in several unrelated genera, and that the arrangement of cells below the stomata which is so characteristic of *Phoenix* is also found in members of the tribe *Borasseae*.

With this point in mind the following are some of the more obvious conclusions which have been deduced so far:

i. Specific differences

It is at once obvious that species from the same genus are not normally distinguishable from each other anatomically. This is because the anatomical differences between closely related species are largely quantitative and in any case the range of variation in structure shown by a single species grown under varied conditions may be greater than the differences between this species and another one. This is not an unexpected result since similar conclusions have been arrived at in anatomical surveys of other families. It merely means that anatomy is of most help to the taxonomist in delimiting taxa at or above the rank of genus.

ii. Generic differences

There are a number of palm genera which are sufficiently isolated for them to be recognized from their leaf anatomy alone. *Borassus, Ceroxylon, Cryosophila, Lodoicea, Nypa,* and *Sabal* are a few of the most obviously distinct genera.

At the other extreme very many genera are almost identical anatomically. For instance members of the tribe *Areceae* usually cannot be separated with any degree of confidence from each other on anatomical grounds and the picture will probably become even more uniform when more members of this group are examined. Similarly, recent revisions of the very large rotang genus *Calamus* have created several new genera which are morphologically very distinct. However, when I came to examine many of these in Singapore, largely through the kindness of Dr. C.X. Furtado, I was unable to find definite anatomical limits between them and the "parent" genus, which is not an unexpected result. What is a surprising result, on the other hand, is that the genera *Calamus* and *Daemonorops*, both of which are climbing rotangs of the Eastern Tropics with very similar habits and which are so closely related that they were frequently confused in early taxonomic work, are very easily distinguished by means of certain anatomical structures in the leaf.

iii. Differences between genera within the same tribe

Within the major groups it is often possible to pick out certain groups of genera which have close affinities. For instance, in the *Sabaleae*, the genera

Licuala, Teysmannia and *Pholidocarpus* show a combination of anatomical characters not found elsewhere. This sort of thing is to be expected and will probably be found to occur frequently as the range of observations is extended because within a single tribe all genera have not an equal affinity with each other.

iv. Tribal differences

Even after a brief examination of the anatomy of palm leaves it was fairly obvious that each of the major groups of palms has a combination of anatomical leaf characters by which it could be recognized. Thus, in just the same way as one could talk about the arecoid inflorescence, or the lepidocaryoid fruit, it is possible to conceive a sabaloid or phoenicoid or arecoid type of leaf section. As an example the following description would apply to all members of the tribe *Caryoteae*:

Leaf dorsiventral. Epidermal cells rhombohedral or spindle-shaped, walls linear. Stomata superficial, guard cells with transverse striations on the ledges conspicuous in surface view (Fig. 10). Hairs usually abundant on the abaxial surface and producing a glaucous bloom of thin-walled, air-filled cells, each group of superficial cells arising from two or three basal thin-walled cells which are surrounded by a cylinder of thick-walled, sclerotic cells (Fig. 11). Hypodermis usually one-layered below each surface. Nonvascular fibres situated in the mesophyll and rarely making contact with the surface layers (Fig. 3). Individual fibres with large, septate lumina. Longitudinal vascular bundles mostly independent of the surface layers and situated at a median depth in the lamina, or towards the abaxial surface. Phloem often sclerotic. Transverse vascular bundles small, sheathed by parenchyma only. Stegmata with a hat-shaped silica body, silica cell thin-walled.

v. Evidence in support of recent taxonomic revision

One very interesting aspect of this present study is that some recent modifications in the classification of palms arrived at from a study of exomorphic features have been confirmed independently by anatomical observations. This is very stimulating and is rather like a detective novel in which the reader is able to identify the criminal from a different set of clues to those provided by the author. For instance, the genus *Orania* was included in the small tribe *Caryoteae* by Drude (1889). An examination of its structure showed that there were many differences between its leaf anatomy and that of the rest of the *Caryoteae* and in addition the genus did not show any obvious affinities with any other tribe of palms. It was therefore very gratifying to discover subsequently that both Beccari and Burret had each included *Orania* in a distinct tribe in their subdivisions of the *Palmae*. Another example is equally clear-cut. When Ridley described the genus *Pholidocarpus* for the *Flora of Malaya*, it was included in the tribe *Borasseae* only to be moved subsequently into the *Sabaleae*. Anatomical evidence supports this change and also suggests that *Pholidocarpus* may be related to the genera *Teysmannia* and *Licuala*.

vi. Concluding remarks

Largely due to lack of material, little anatomical work has been done on a number of small groups of palms which have undergone recent taxonomic revision (see Appendix). It is hoped that when more anatomical evidence becomes available it will be allowed to contribute its weight in arguments about the affinities of the larger groups of palms. Most interesting results from this type of work are produced when the anatomist is able to work in close co-operation with his taxonomic colleague. Dr. H. E. Moore, Jr. has promised to give advice on taxonomic matters which will probably save me much muddled thinking.

Some practical value should also be obtained from the results because identification of sterile and fragmentary material may be made possible. This can be of assistance to the ecologist, the archaeologist, the economic botanist, or even the horticulturist.

One further point of general usefulness may also be a result of this survey in that the development of the leaf and other organs of the palms which has

long been enigmatic to botanists, will be made more amenable to study when our knowledge of the anatomy of the mature organs is more complete. The main object at the moment is to assemble all the details in one volume.

Appendix. Palm Material Required for Anatomical Study

The following is a list of the palm genera (classification of Drude) of which material is required to make the anatomical survey as complete and useful as possible. Since most of the palms required are American it is thought that members of the Palm Society may be in a position to supply me with material, particularly of the less well known genera. Of course it may be difficult to obtain all parts of each species, that is stem, leaf and root, and it is understood that members may jib at the idea of tackling a 60-foot palm to gratify the wishes of a foreign scientist. However, as is emphasized earlier, it is the lamina of the palm which is of most value for systematic anatomy and it may be a simple matter to snip off a leaflet or two. The material should be fixed in spirit or preferably, in formalin-acetic-alcohol. It can be mailed in a sealed polythen bag, enclosing a wad of damp cotton wool. If these facilities are not available the leaf in a well dried state will be extremely useful. If any member of the Society is willing to help I will be only too glad to supply further details.

TRIBE SABALEAE

Rhapidophyllum *Brahea*
Nannorhops *Cryosophila*
Serenoa

TRIBE MAURITIEAE

Lepidocaryum *Mauritia*

TRIBE GEONOMEAE

Manicaria *Asterogyne*
Leopoldinia *Calyptrogyne*
Calyptronoma *Welfia*
Geonoma

TRIBE IRIARTEAE

Catoblastus *Wettenia*
Iriartea *Juania*

TRIBE MORENIEAE

Morenia *Pseudophoenix*
Kunthia *Reinhardtia*
Gaussia

TRIBE ATTALEEAE

Orbignya

TRIBE ELAEIDEAE

Barcella *Corozo*

TRIBE ARECEAE

Prestoea *Roscheria*
Gigliolia *Oenocarpus*
Linospadix *Cyphokentia*
Iguanura *Hydriastele*
Sommieria *Loxococcus*
Clinostigma *Cyphophoenix*
Jessenia

SUBFAMILY PHYTELEPHANTOIDEAE

Phytelephas

Pelagodoxa Henryana

Pelagodoxa Henryana is one of the most fascinating rarities among the cultivated palms. The species is rare even in its native habitat—valleys on Nuku Hiva (Nukahiva), Hiva Oa, and Tahuata. all volcanic islands in the Marquesas Islands lying some 700 miles northeast of Tahiti.

Our first published record of this unusual palm appears in a French horticultural journal, *Revue Horticole* (ser. 2, 15: 302. 1917). There, D. Bois incorporated a formal description, provided by Odoardo Beccari, with photographs of a small plant, seedlings, a drawing of fruits, and notes from Charles Henry, who discovered the palm on Nuku Hiva. According to Henry, the plants, of which he saw only twelve, grew at a low altitude in the shade of *Hibiscus tiliaceus* where they never saw the sun. In describing them, he wrote (translated) "I have rarely seen a more beautiful palm. Some individuals four to five years of age, straight of stem, have the appearance of adult specimens

PELAGODOXA HENRYANA photographed in the garden of Mme. Vve. De Flesselle in Papeete, Tahiti, 1937. The plant was found wild in the Typee Valley on Nuku Hiva, Marquesas Islands. Stilt roots have developed on this young tree but do not appear on plants grown in the Fiji Islands and in the Panama Canal Zone. The photograph was presented to Dr. L. H. Bailey by the late Captain A. Johnston.

of *Kentia;* the large, entire, pleated leaves, silvered below, give them a special quality."

Although mention was made of *Pelagodoxa Henryana* in the *Bulletin de la Société Botanique de France* (ser. 4, 19: 12, 1919), no additional information appeared until 1932 when Professor Ugolino Martelli, then at the University of Pisa, Italy, gave a much more detailed account in *Nuovo Giornale Botanico Italiano* (ser. 2, 39: 243-250). From Professor Martelli, we learn that Father Simeone Delmas, a French missionary, had supplied him with more material collected near Taiohae at the foot of the waterfall of Vai-pivai, seven kilometers from the coast of Nuku Hiva and probably the same place where Henry originally found *Pelagodoxa.* Father Delmas is also the authority for reports of the palm at Puawan on Hiva Oa and on Tahuata. Plants were cultivated by Father Delmas and by others but those grown near the sea did not survive. The species has also been grown in Tahiti as the accompanying photograph shows.

Pelagodoxa Henryana grows naturally at an altitude of about 80 meters (about 260 feet) on the banks of a torrent in the bottom of a valley only a short distance from a waterfall that drops from an altitude of 200 meters and fills the air with mist, thus providing a very humid atmosphere. It would appear, then, that shade and high humidity are important factors to be considered in growing the species. Attempts to grow it in Europe were unsuccessful and although it has been tried in southern Florida I have not seen a mature specimen there. Conditions in the Panama Canal Zone, however, seem more favorable, for a handsome group of trees has reached maturity in the Experimental Gardens at Summit.

The description that follows below is taken largely from my notes, color photographs, and specimens made at Summit in 1953. The exact relationship of *Pelagodoxa* with other palms of the arecan type is not yet fully understood although in many ways it seems close to *Manicaria,* especially so in the strange warty fruit. A second species, *Pelagodoxa mesocarpa,* is known only from some drawings and an empty fruit which supposedly came from New Caledonia. Burret, who described the species in 1928, doubted that New Caledonia was correct as a source and suggested that the Philippine Islands might be the possible place of origin.

Pelagodoxa Henryana has solitary brown trunks reaching a height of about 24 feet and often thickened or sometimes bearing stilt roots at the base. About ten leaves at first ascending and later spreading, form a graceful crown that lacks a crownshaft. When young, the broad green blade is undivided except for a rather deeply toothed margin. It has a yellowish midrib and stout lateral nerves but when older it tends to become deeply frayed into nearly separate one-to-several-nerved segments unless protected from the action of wind. The lower surface has a grayish-silvery cast. Blades may be as much as six feet or more long and somewhat less than half as wide with short stiff petioles about eight inches long, these being covered with a white "felt" at least on the lower side. The stiffish green panicles are borne among the leaves from the axils of a somewhat fibrous outer bract and a thin rounded pointed inner bract. Lower branches of the panicle are often again branched, the upper are usually unbranched. Female flowers appear after the male flowers have dropped but then only in the lower fourth of each rachilla where they are sunken in shallow pits. The upper three-fourths of each rachilla bears male flowers only, these small, yellowish, about one-eighth inch long, bearing six stamens, and usually paired in pits. Twelve to sixteen large, prominently warty, thick-skinned, round fruits as much as six inches in diameter are borne on each panicle. These fruits contain round seeds in which the ivory-white homogeneous endosperm surrounds a hollow center.

If viable seed can be located, *Pelagodoxa Henryana* would surely warrant the special treatment that would appear to be necessary to grow it in the United States. Living plants would not only add a handsome ornamental rarity to our lists of cultivated palms, but would provide the study material still needed before all aspects of the species are known to science.—H.E.M.

Rhyticocos Amara

W. H. HODGE

This interesting species, christened the "Overtop Palm" by L. H. Bailey, appears to have been making its debut as a horticultural subject and so it may be worthwhile to supply palm enthusiasts with some background information on the plant as it occurs in its native haunts in the Lesser Antilles.

I first became acquainted with this then little-known palm about 20 years ago while undertaking botanical exploration in the British West Indian island of Dominica (not to be confused with the Dominican Republic on the island of Hispaniola in the Greater Antilles). About the same time Dr. Bailey was meeting with it on the adjoining French islands of Guadeloupe and Martinique. On the basis of collections from Dominica and the French Antilles encompassing the then known range of the palm, he prepared the first really complete description and taxonomic account of this monotypic species (Rhyticocos—the Overtop Palm. *Gentes Herbarum* 4:366-372.1940). A year or so later the range was extended to St. Lucia, the next island south of Martinique, by Dr. John Beard, who located "tall groves" of *Rhyticocos* in scrub woodlands at a single restricted locality on the leeward coast. *Rhyticocos* is thus definitely known to be an endemic palm limited to the central volcanic isles of the Lesser Antilles.

On the basis of present knowledge the species as it exists today is apparently most abundant in the wild in Dominica where it occurs chiefly on the northwestern and northeastern coasts. This is not to be wondered at if one realizes that Dominica, although a small island with a total area of only 300 square miles, has very mountainous terrain and has not therefore attracted man and his agriculture to the extent of less rugged neighboring islands. Dominica's original forest resources including the native palms have thus not suffered as much at the hands of man.

Rhyticocos is primarily a coastal species, inhabiting the drier scrub woodlands that form the climax vegetation typical of lower elevations in the Antilles. In Dominica, at least, this palm does not grow much above an elevation of 1000 feet, and only occurs at that altitude on the leeward (western) coast where, because of the rain-shadow effect of the interior mountains, it seems to be too dry at sea level for its successful growth. On the moister, windward (eastern) coast *Rhyticocos* grows upon the lower slopes and rocky bluffs close to the Atlantic and often within reach of the salt spray continually carried by the incessant Trade Winds. It must also bear the brunt of the seasonal hurricanes regularly born in the sea to the east of these islands. The foliage of this palm seems to be unaffected by salt spray and this should make *Rhyticocos* of interest to those desiring a tall slender palm for seaside plantings.

Its native region of growth, though described as "dry," is really wet by most standards for the annual coastal rainfall where this palm grows probably runs from around 60 to 90 inches. To be sure, the effectiveness of this precipitation is reduced by the "run off" caused by the steep slopes made up largely of poor quality soils, often red clay, with poor drainage characteristics. The annual temperature spread is small with an average maximum of 84° F. and an average minimum of 75° F.

Generally to be found scattered over the terrain that it occupies, the palm is at times gregarious, forming tall groves. the individual trees often standing high above all associated vegetation. The slender straight trunks may run from 30 to 50 feet high. The taller specimens usually grow in the more fertile soil and shelter to be found in small river valleys. In general vegetative habit

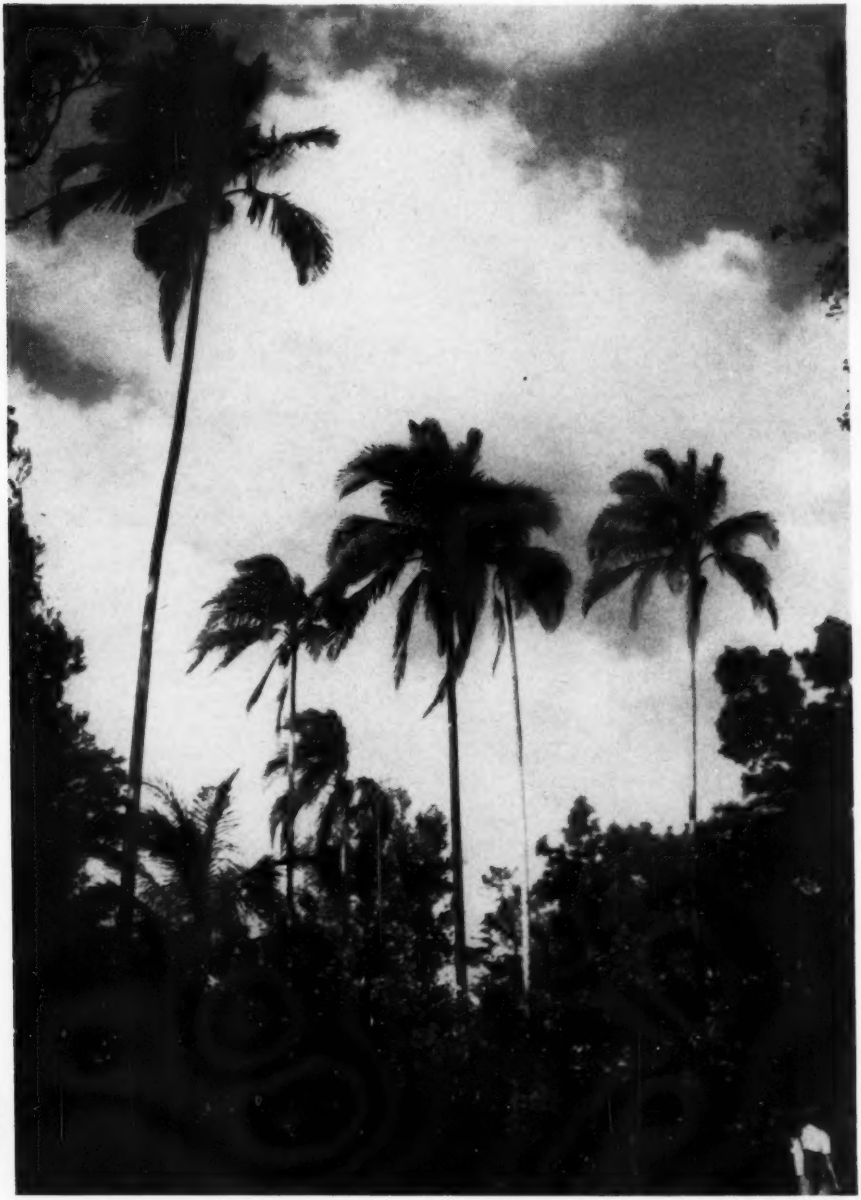


Photo by W. H. Hodge

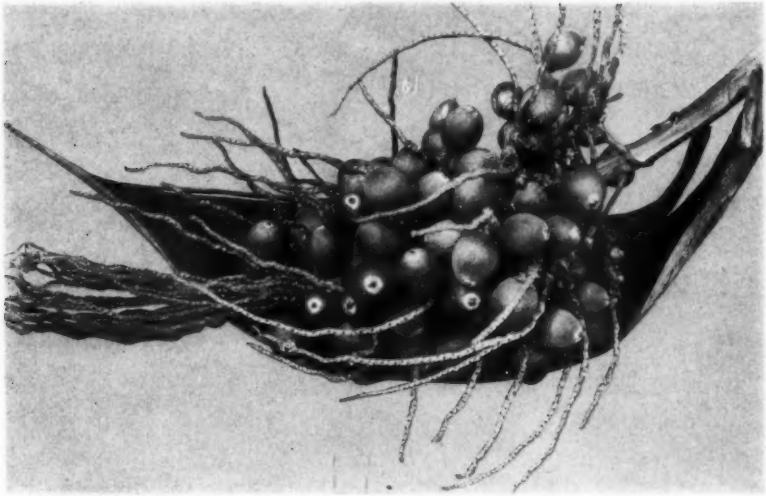
RHYTICOCOS AMARA. A small grove of the Overtop Palm at about 700 feet elevation on the leeward coast of Dominica, east of Dublanc.

Rhyticocos looks like a slender but erect coconut palm and this likeness may even be extended to its attractive orange-colored fruits which, about the size of hens' eggs, look like miniature coconuts, even containing a milk (which is, however, bitter as reflected in the specific name "amara") when young. The clustered fruits are associated with attractive woody spathes which hang conspicuously from among the petiole bases of the attractive pinnate leaves. Actually *Rhyticocos* is rather closely related to the genus *Cocos*, so close in fact that it was originally described as *Cocos amarus* in 1763 by the Austrian Count Jacquin on the basis of specimens from Martinique. On that island it is known today as Petit Coco and in Dominica one of its names is Coco Nain, both names meaning "dwarf coconut."

Jacquin may have been the first to have originally written about this Lesser Antillean palm, but aborigines long before him appreciated it in their own way. The volcanic Caribbee Islands were the stronghold of the most savage of all the West Indian tribes, the Island Caribs, cannibals whose villages and encampments dotted the islands as far north as Puerto Rico. In the islands where the Overtop Palm grew it was known to the Indians as *iátaho*, a name now corrupted in the Creole patois of Dominica to Yattahou. To the Caribs the Overtop Palm was a utilitarian plant. According to Father Breton, an early French priest who compiled in 1665 one of the earliest Carib dictionaries, the Indians tapped the terminal bud of this palm and the liquid exudate so obtained was made into wine. The fruits likewise were utilized for making a fermented drink. Oil expressed from the bitter kernels of the nut (extracted by grating and boiling the endosperm) was one of the natural oils mixed with the red arillate coloring obtained from the seed of annatto (the tropical American shrub, *Bixa orellana*, the ornamental "Lipstick Tree" of South Florida) to make the favorite red double-purpose body and insect repellant paint of the Caribs. Even though bitter, the nut kernels are often eaten by contemporary Carib children.

Undoubtedly Columbus was the first European to see *Rhyticocos*, for Dominica was the first landfall of his second voyage in 1493. He could hardly have failed to see this palm for on the eastern windward bluffs of the island it is the only common palm and, as indicated above, its crown grows conspicuously above most of the surrounding plants of the coastal woodlands. As a matter of fact, another probable Carib use of the Overtop Palm is recorded in 1494 in a well-known letter of Dr. Diego Chanca (Surgeon on Columbus' flagship) who described the houses of the coastal villages of neighboring Guadeloupe as being thatched with straw. More recent studies have pointed out that what looked like straw (on a heavily forested island no source of straw was available) was very likely thatch of plaited palm-leaves, a thatching material much used in the wet tropics. Judging from its present distribution *Rhyticocos* was the only readily available palm along the coast that could have been used for this purpose.

In his 1940 account in Gentes Herbarum Dr. Bailey reported that the Overtop Palm was then locally planted in gardens in the French Antilles as a horticultural subject. He also added that "this palm should add an interesting and attractive variety to plantations in the warmest parts of the United States." Fortunately this prediction is approaching fulfillment, reports in PRINCIPES indicating that this handsome economic plant of the Island Caribs is now being grown by some palm enthusiasts in Florida for its beauty alone.



RHYTICOCOS AMARA in fruit. The bract, not counting the curve, is 31 inches long. (Reprinted from *Gentes Herbarum* 4:371, *fig. 234.* 1940.)

RHYTICOCOS AMARA. Fresh fruit, approximately three-fourths full size. (Reprinted from *Gentes Herbarum* 4:371, *fig. 235.* 1940.)

It is now possible to state definitely that the dwarf *Reinhardtia* introduced by David Barry, Jr. from Mexico and mentioned in PRINCIPES 1:136 is *Reinhardtia gracilis* variety *gracilior*. Before leaving for Mexico, Dent Smith kindly forwarded male flowers of plants growing in his garden to the editor. These flowers have ten stamens and in other respects agree with variety *gracilior*.

The African Relative of the Chilean Wine Palm

DAVID BARRY, JR.

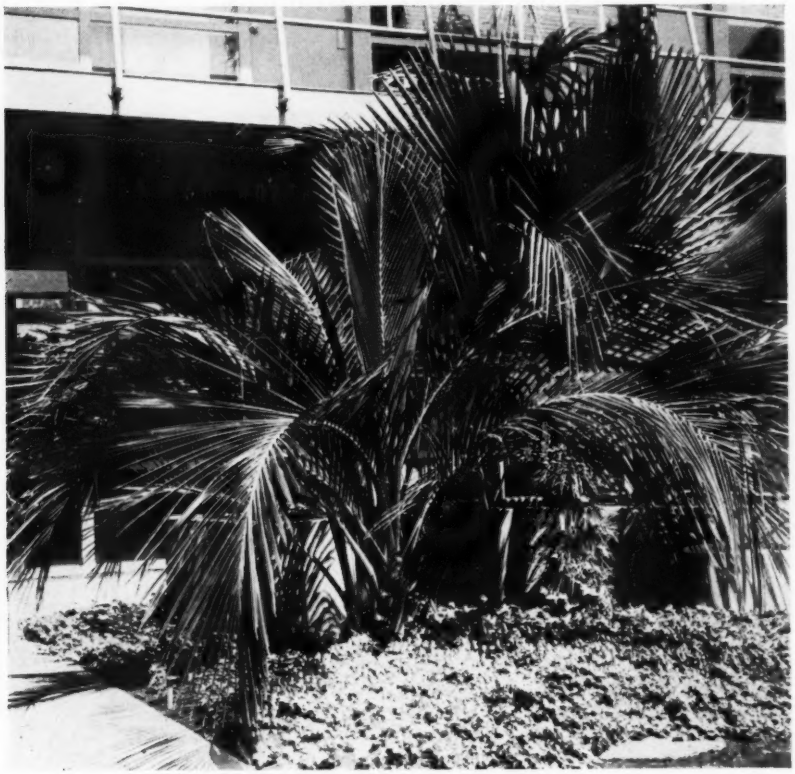
The origin of plants is often stated simply as either Old World or New World. Sometimes it is necessary to point out exceptions to this easy generalization. For example, bromeliads were thought to be exclusively New World until a few years ago when an apparently indigenous species was found in Africa. *Cocoideae,* or cocoid palms (not including the coconut palm, whose origin is obscure and controversial) were also considered to be solely New World plants until about 1913. In that year Odoardo Beccari of Florence, Italy, palm authority of his day, described a newly discovered cocoid palm from South Africa—*Jubaeopsis caffra.* This kaffir palm, "like a *Jubaea,*" is a relative, surprisingly enough, of the wine palm *Jubaea chilensis.*

In the late thirties I sought seeds of this new palm in the belief that the species would live in the coastal belt of Southern California, where many other South African plants are at home. The small lots of seed that I managed to secure from time to time came by steamer because there was no airmail out of Africa at that time. In spite of special attention to packaging to prevent dessication during the slow passage, none of the seeds arrived in viable condition. At least, and to my disappointment, none germinated over bottom heat.

In 1939, Miss K. C. Stanford, the late plant and seed merchant of Stellenbosch, near Capetown, wrote that she had received word from a correspondent up-country that seeds of *Jubaeopsis caffra* could be secured. She stated that the opportunity to obtain seeds was exceptional and asked that I respond immediately if interested in a supply. The seeds were ripening and would have to be collected before baboons destroyed them. Having already been informed that the "boys" in the bush also eat the seeds while green, i.e., with a soft endosperm, I hastened to send Miss Stanford an order. Some weeks later a shipment of several hundred seeds arrived, of which about two dozen germinated.

In sowing the seed it was necessary to use containers about two feet in depth. In tropical countries it would be advisable to sow the seed *in situ.* The deep containers are necessary to keep the hypocotyl, or radical, that emerges from one of the three eyes of the seed, from corkscrewing and smothering itself in the confines of a shallow container. The formation of the plantlet by the leaves growing up and the roots growing down begins at a point on the descending hypocotyl when sufficient depth has been reached to protect the development from drought. It is evident that a vertical descent of the hypocotyl to at least eighteen inches below the surface of the soil is necessary before the plantlet will begin to develop. This growth habit is also a characteristic of the African palms of the genus *Hyphaene* and of *Bismarckia* from Madagascar. It has been stated that these palms can not be germinated in pots. This contention falls when the propagator uses pots of sufficient depth.

Ten years later the plants were well established in large nursery containers. They had reached a height of four to five feet, and their fronds were six feet in length. Many had divided into double heads. At the time they had not yet experienced a cold test. In the winter of 1949, however, we were hit by a severe freeze of the kind that visits Southern California about every decade. Even in mild "frost-resistant" localities temperatures dropped to several degrees below 32° F. One-third of these African palms succumbed to cold. With this experience I have concluded that this palm is about as hardy as *Howeia, Archontophoenix,* and *Rhopalostylis.*



JUBAEOPSIS CAFFRA with four crowns (left), *Trithrinax acanthocoma* in background (right).

The surviving plants continued to divide. Some of them now have four crowns and give evidence of further division. This development of multiple trunks is not by the formation of new growths that are horizontal offshoots from a mature trunk at ground level, as in *Chrysalidocarpus, Ptychosperma,* or *Chamaedorea.* Instead, the division occurs high in the crown or leaf cluster of the plant. A moderately thicker-than-normal spike of unopened leaves divides into two spikes with half of the surrounding leaves forming the crown for each of the new spikes, respectively. The species may be propagated by division that is easily done by a vertical cut with a saw between leaf crowns.

The plants produce several long slender spathes from which many-flowered spadices emerge. The male flowers produce an abundance of pollen. Self-pollination does not seem to take place. It might be assumed that an insect that does not live in California is needed to carry pollen from the male to the female flowers. After hand pollination a swelling of the female flowers takes place that predicts the development of seed. Unfortunately after two or three weeks the swollen flowers fall. Once, however, two seeds did attain full development. Unfertilized flowers fall quickly.

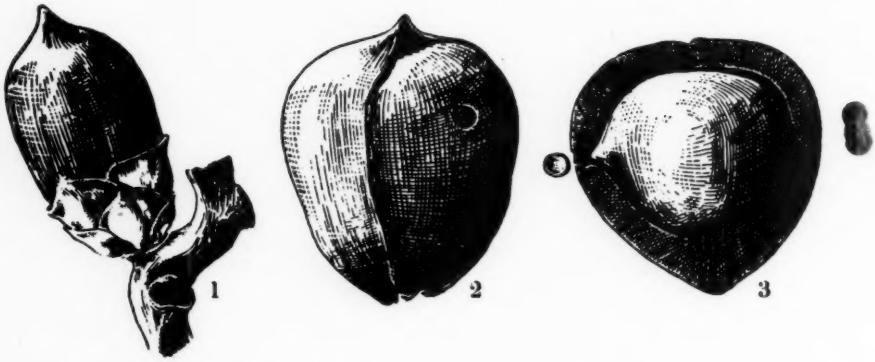
The leaves of *Jubaeopsis* are graceful, arching, and abundant. The species has promise of great beauty, and would be especially attractive if the trunks were to shed their leaf bases and arise from the ground as clean, smooth columns. The characteristic of self-cleaning trunks is expected to be found in mature cocoid palms. The size of a mature plant of the species given in the description below suggests that eventually a development of this nature takes place.

From The Flora of South Africa 4: 48,1915, by Rudolf Marloth, text and figures reproduced with permission of the publishers:

genus are situated near the base of the nut, but in *Jubaeopsis* near its equator. The endosperm is hollow, as in the coconut, and also of a sweetish taste, but without milk.

"A tree up to 20 feet high, with leaves 12—15 feet long. The male flowers are inserted on the upper parts of the branches of the spadix and possess 8—16 stamens, the female flowers being on the lower parts. The fruits are about the size of walnuts, but nearly globular, the fibrous pericarp being yellow when ripe.

"The palm occurs, as far as known, only at two localities in Pondoland, viz. at the mouths of the Umsikaba and the



FRUIT OF JUBAEOPSIS CAFFRA reproduced from Marloth. 1, young fruit; 2, ripe fruit with the pericarp partly removed; 3, nut in longitudinal section, the seed entire but the plug of the germinating hole detached.

"Until quite recently only two genera of palms were known from South Africa. A few years ago Mr. Charles Ross, then conservator of forests at Umtata, reported the occurrence of another kind in Pondoland. This has now been found to be the representative of a new genus, named *Jubaeopsis*, from its nearest ally, *Jubaea*, a monotypic genus of South America (Chili).

"The fruit of *Jubaeopsis* differs from that of *Cocos* by the position of the germinating holes, which in the latter

Umtentu rivers, in both cases only on the northern bank and in close proximity to the water. As this is, apart from the widely spread coco-nut palm, the only member of the tribe which occurs in Africa, all the others being American, its discovery throws some new light on the origin of the Cocoineae and the relationship of our flora."

The other two genera of South African palms mentioned by Marloth are represented by the species *Phoenix reclinata* and *Hyphaene crinita*.

PALMS IN TEXAS

Mrs. Sulema Etchison of Brownsville, Texas, has written the Executive Secretary a letter that we feel should be shared with other members of the Society. With Mrs. Etchison's permission, the following paragraphs are reproduced:

"The growing of palms has always been of some interest to me. For a number of years, however, I had no ground on which to grow them. There are very few kinds offered by our local nurseries, so I got Dr. Ledin's name and address from some forgotten source several years ago, and he kindly sent me some seeds from the Sub-Tropical Experiment Station.

Then Mr. Harold Loomis told me about the Palm Society. It has been a great spur to my interest. And how it has made me realize the extent of my ignorance! Last summer I spent a week in Florida en route to Puerto Rico. I saw in both places a wealth of palms, many of which I had never even heard of before. The palms at Fairchild Tropical Garden simply made "my mouth water."

There is, of course, a direct interest in growing palms from seeds of unknown species. But my compelling reason for growing them from seeds is twofold: economic, meaning I am too darn poor to afford the ones I want in the quantity and sizes I yearn for; and necessity, meaning that many kinds that appear worth trying in this area are not available from any nurseries that I have been able to contact.

You who live in Florida where much work has been done on palms already cannot begin to realize how difficult and trying it is even to find sources from which to buy, assuming the financial ability to buy freely. Some of the palms on my list were purchased last summer from Mr. Johnston at Vero Beach, and were brought home in the car of Beverly Wheelock, Palm Society member.

I would like to add that I have also had considerable help from Mr. James E. Smith of Oakland Park. He is familiar with this area, and he sent me a marked catalogue indicating which palms he thought were worth trying. In addition, he wrote me several letters of guidance and instruction, giving me far more time and attention than the value of my purchases from him dictated.

I have written so much that you will regret that you ever asked me anything about my palms, so I will now hush about my troubles and list my treasures. Most are small plants. *Acrocomia mexicana; Adonidia Merrillii, Aiphanes acanthophylla* and *A. caryotaefolia; Archontophoenix Alexandrae* and *A. Cunninghamiana; Arecastrum Romanzoffianum; Arenga Engleri; Arikuryroba schizophylla; Bismarckia nobilis; Butia capitata; Caryota mitis* and *C.* sp.; *Chamaedorea erumpens* and *C.* sp.; *Chamaerops humilis; Chrysalidocarpus lutescens, C. madagascariensis,* and *C.* sp.; *Coccothrinax argentea; Collinia elegans; Copernicia glabrescens* and *C. Torreana; Dictyosperma album* var. *rubrum; Elaeis guineensis; Erythea armata; Howeia Belmoreana; Latania Loddigesii; Licuala amplifrons; Livistona australis* and *L. chinensis; Mascarena lagenicaulis; Opsiandra Maya; Paurotis Wrightii; Phoenix acaulis, P. canariensis, P. paludosa, P. pusilla, P. reclinata, P. Roebelenii, P. rupicola, P. sylvestris,* and *P. zeylanica; Ptychosperma Macarthuri; Rhopalostylis sapida; Rhapis humilis; Roystonea elata* and *R. regia; Serenoa repens; Syagrus* sp.; *Thrinax parviflora; Veitchia Joannis; Washingtonia* sp."

WANTED ★ FOR SALE ★ EXCHANGE

If you want seeds or plants of hard-to-find palms, let others know through PRINCIPES. If you have something to offer, this page is your opportunity to do so. Members of the Society constantly write: "Where can I get unusual palms?" Look in PRINCIPES — perhaps someone near you has just what you are looking for. Rates: 25c a line or part of a line, minimum, $1.00. Kindly remit to Mr. Nat De Leon, 8300 S. W. 62nd Pl., Miami 43, Fla.

Want to buy: sturdy plants, approx. gal. can size, *Raphia Ruffia, Acrocomia Totai, Jubaea spectabilis, Archontophoenix Cunninghamiana, Arenga pinnata.* State plant size, price. Mrs. Sulema Etchison, 1624 Central Blvd., Brownsville, Texas.

PALMS OF MADAGASCAR, one volume in the series: "Flora of Madagascar and the Comores," by Humbert et al, paper bound, 186 pp., many line drawings, $4.50; may be ordered from E. A. Menninger, Stuart, Fla.

WANTED: 10 lbs. seed Seaforthia elegans. Also price lists various seeds. Edward Roehrs, Exotic Plants, Arecibo, Puerto Rico.

Rhyticocos amara, Dominican Palm. Strong plants in gal. cans, 15-18 inches high. $5.00 postpaid in Florida, extra for longer distances. We have several other interesting items. Write or come see us. Reasoner's Tropical Nurseries. P. O. Box 828, Bradenton, Fla.

Acrocomia fusiformis, 5-gal. size, heavy full. *Livistona Hoogendorpii (cochinchinensis),* 5-gal. size. $15.00 each, ship Railway Express. NO SHIPPING: Aiphanes, Arenga, Bismarckia, Chamaedorea Tepejilote (6-ft. size), Copernicia, Corypha, Elaeis, Hyphaene thebaica (branching palm), Latania, Mauritia, Raphia, Rhapis. CYCADS: Dioon, Encephalartos, Macrozamia, many others. Ed Johnston, Box 974, Vero Beach, Fla.

Numerous kinds of palms, large and small. U. S. certified free from Mediterranean Fruit Fly and Burrowing Nematodes. Send for list with sizes, prices. Smith's Nursery, P. O. Box 508, Oakland Park, Fla.

PHOTOS — Am compiling illustrated palm book. Need photographs of following genera, any species:

Bacularia	Iguanura
Balaka	Iriartella
Catoblastus	Kentiopsis
Ceroxylon	Leopoldinia
Clinostigma	Lepidocaryum
Clinosperma	Nenga
Cyrtostachys	Neodypsis
Didymosperma	Neonicholsonia
Diplothemium (not caudescens)	Pigafetta
	Plectocomia
Eugeissonia	Plectocomiopsis
Exorrhiza	Podococcus
Hedyscepe	Prestoea
Hemithrinax	Salacca
Hexopetion	Teysmannia
Hydriastele	Yuyba
Hyospathe	

Also interested buying seeds or seedlings of any above. James C. McCurrach, 810 S. Ocean Blvd., Palm Beach, Fla.

A member in Brazil wants seeds of *Serenoa repens,* from the plants with BLUE-GRAY leaves ONLY. To be used in landscape design. If you can furnish me with a few good viable seeds, please contact R. G. Wilson, 9550 S. W. 67th Ave., Miami 56, Fla.

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